

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS

-1- (Currently Amended)

A process for depositing a nanocrystalline diamond film with a grain size between 1 and 100 nm on a surface of a substrate, which comprises:

(a) providing a plasma generating apparatus for depositing the diamond film on the substrate from the plasma including a plasma source employing a radiofrequency, including UHF or microwave, wave coupler means which is metallic and in the shape of a hollow cavity and which is excited in a TM mode of resonance and optionally including a static magnetic field around the plasma which aids in coupling radiofrequency energy at electron cyclotron resonance and aids in confining ions in the plasma in an electrically insulated chamber means in the coupler means, and wherein the chamber means has a central longitudinal axis in common with the coupler means and

is mounted in closely spaced and sealed relationship to
an area of the coupler means with an opening from the
chamber means at one end; gas supply means for
20 providing a gas which is ionized to form the plasma in
the chamber means, wherein the radiofrequency wave
applied to the coupler means creates and maintains the
plasma around the central longitudinal axis in the
chamber means; movable metal plate means in the cavity
25 mounted in the coupler means perpendicular to the
central longitudinal axis and movable along the central
longitudinal axis towards and away from the chamber
means; and a movable probe means connected to and
extending inside the coupler means for coupling the
30 radiofrequency waves to the coupler means;

(b) providing the substrate, wherein the
surface to be placed in the plasma has been roughened
and cleaned; and

(c) providing the substrate in the insulated
35 chamber on a substrate holder adjacent to the plasma
generated in the chamber, wherein the gas in the
chamber is at a pressure between 50 and 300 Torr in the

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

presence of the radiofrequency waves for generating the plasma, wherein the gas is ninety percent by volume or
40 more of argon along with methane and optionally hydrogen and essentially free from without oxygen or nitrogen and wherein the chamber is essentially free from leaks of nitrogen or oxygen or mixtures thereof into the chamber, so as to generate the plasma and to
45 deposit the nanocrystalline diamond film on the substrate.

-2- (Original)

The process of Claim 1 wherein the substrate has a dimension with a surface area greater than about 20 cm².

-3- (Original)

The process of Claim 1 or 2 wherein the microwave is at 2.45 GHz.

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

-4- (Original)

The process of Claim 1 or 2 wherein the microwave is at 915 MHz.

-5- (Original)

The process of Claim 1 or 2 wherein the film has a thickness of at least about 50 nm micrometers.

-6- (Withdrawn)

A nanocrystalline film prepared by the process of Claim 1.

-7- (Withdrawn)

A nanocrystalline film prepared by the process of Claim 2.

-8- (Original)

The process of Claim 1 wherein the substrate is allowed to thermally float at a temperature between about 575°C and 900°C on a side exposed to the plasma.

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

-9- (Original)

The process of Claim 1 wherein diamond particles are used for providing the roughened surface by abrasion and wherein the diamond particles have a grain size between about 0.1 to several micrometers, which surface is then cleaned.

-10- (Original)

The process of Claim 1 wherein the pressure on the gas is between about 60 and 240 Torr and at a flow rate of between about 50 and 200 sccm.

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

-11- (Original)

The process of Claims 1 or 2 wherein the probe means is elongate and is mounted in the coupler means along the central longitudinal axis of the chamber means and coupler means with an end of the probe means in spaced relationship to the chamber means; and wherein stage means in the opening of the chamber which forms part of the cavity and provides for mounting the substrate, the stage means having a support surface which is in a plane around the longitudinal axis and which is pre-adjusted towards and away from the plasma in the chamber means so that the substrate can be coated with the diamond film from the plasma.

-12- (Original)

The process of Claims 1 or 2 wherein the insulated chamber is evacuated so that there is less than about 10 ppm of combined oxygen and nitrogen or nitrogen or oxygen alone as the gas which generates the plasma is provided in the chamber.

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amdt. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

-13- (Original)

The process of Claims 1 or 2 wherein the substrate is silicon and wherein the substrate holder is molybdenum.

-14- (Original)

The process of any one of Claims 1 or 2 wherein the substrate on which the diamond is deposited has a surface area with a diameter which is greater than about 8 cm.

-15- (Original)

The process of Claim 1 wherein the gas contains about 1% methane.

-16- (Original)

The process of Claim 1 wherein the mode of the plasma is selected from the group consisting of TM012 and TM013.

Attorney Docket No. MSU 4.1-572
Appl. No. 10/073,710
Amtd. Dated: July 29, 2004
Reply to Office Action of 05/04/2004

-17- (Original)

The process of Claim 1 wherein at pressures of greater than about 250 Torr the stage means can be optionally cooled.

-18- (Original)

The process of Claim 1 wherein the substrate is a silicon carbide seal and the holder is molybdenum which shields a first portion of the seal while allowing a portion of the seal to be coated with the nanocrystalline diamond.

5 -19- (New)

The process of Claim 1 wherein the apparatus has a static magnetic field around the plasma which aids in coupling radiofrequency energy at electron cyclotron resonance and aids in confining ions in the plasma in an electrically insulated chamber means in the coupler means.